

WHAT IS CLAIMED IS:

1 1. A method for preparing multicrystalline substrates as handling wafers for
2 subsequent bonding to device layer materials, the method comprising the steps of:
3 providing an initial multicrystalline substrate;
4 polishing the multicrystalline substrate to reduce surface roughness to
5 about 5 nm;
6 forming a filler layer overlying the face of the substrate to a predetermined
7 thickness, the filler layer comprising a surface that is substantially free from
8 indications of the multicrystalline arrangement; and
9 further polishing the surface of the filler layer to form a substantially
10 smooth upper surface on the substrate,
11 wherein the substantially smooth upper surface is characterized by a
12 surface roughness of twenty Angstroms or less.

1 2. The method of claim 1, wherein the initial substrate is selected from a
2 polycrystalline silicon wafer, a glass substrate, a ceramic substrate, an organic film, a
3 metal substrate, and an amorphous wafer.

1 3. The method of claim 1, wherein the initial substrate has a typical crystalline
2 dimension of about 0.5 to 10 millimeters in size.

1 4. The method of claim 1, wherein the filler layer is selected from a CVD oxide, and
2 a polycrystalline silicon.

1 5. The method of claim 1, wherein the filler layer is removed to a thickness of one
2 half or more of the predetermined thickness.

1 6. The method of claim 1, wherein the filler layer is a polycrystalline silicon, the
2 polycrystalline being formed using a low pressure chemical deposition technique.

1 7. The method of claim 1, wherein the filler layer is chosen from the group
2 consisting of an insulating layer and/or a composite layer.

1 8. The method of claim 1, wherein the surface roughness is five Angstroms or less.

1 9. The method of claim 1, wherein the filler layer is made by a chemical deposition
2 process or a sputtering process.

1 10. The method of claim 1, wherein the substrate is a ground substrate or unpolished
2 substrate.

1 11. The method of claim 1, wherein the polishing process is a chemical mechanical
2 polishing technique comprising:

3 applying a mechanical fine-grinding step;
4 applying a rough polishing step using a weakly alkaline slurry;
5 changing the composition of the slurry by feeding a neutral polishing
6 slurry to the polishing pad and gradually reducing supply of rough polishing slurry; and
7 wherein surface roughness after polishing is 0.5 nm or less.

1 12. The method of claim 1, wherein the polishing process is a chemical mechanical
2 polishing comprising:

3 applying a mechanical fine-grinding step;
4 applying a rough polishing step using a weakly alkaline slurry;
5 adding TMAH to the slurry to adjust the alkalinity of the slurry for
6 increased removal rates while maintaining material removal rates relatively constant
7 between various grain regions of the substrate; and
8 effecting a controlled transition to a second slurry composition to obtain
9 microscopically smooth surfaces;
10 wherein surface roughness after polishing is 0.5 nm or less.

1 13. The method of claim 1, wherein the polishing process is a double-sided chemical
2 mechanical polishing technique comprising:

3 applying a mechanical fine-grinding step;
4 applying a rough polishing step using a weakly alkaline slurry;
5 changing the composition of the slurry by feeding a neutral polishing
6 slurry to the polishing pad and gradually reducing supply of rough polishing slurry; and
7 wherein surface roughness after polishing is twenty Angstroms or less.

1 14. The method of claim 1, wherein the polishing process is a double-sided chemical
2 mechanical polishing technique in which polishing is done on a double-sided polishing
3 machine to polish front and back sides of the substrate simultaneously, comprising:

4 applying a mechanical fine-grinding step;
5 applying a rough polishing step using a weakly alkaline slurry;
6 adding TMAH to the slurry to adjust the alkalinity of the slurry for
7 increased removal rates while maintaining material removal rates relatively constant
8 between various grain regions of the substrate;
9 effecting a controlled transition to a second slurry composition to obtain
10 microscopically smooth surfaces;

11 wherein the front and back side each achieve a flatness of 0.5 micron or
12 less; and

13 the front side achieves a roughness of 0.5 nm or less.

1 15. Electronic devices made from bonded assemblies prepared using the method of
2 claim 1.

1 16. Micro-Electro-Mechanical Structures (MEMS) made from bonded assemblies
2 prepared using the method of claim 1.

1 17. Micro-Opto-Electro-Mechanical Structures (MOEMS) made from bonded
2 assemblies prepared using the method of claim 1.

1 18. A method for polishing substrates, the method comprising steps of:
2 applying a rough polishing step using a weakly alkaline slurry;
3 changing the composition of the slurry by feeding a neutral polishing
4 slurry to the polishing pad and gradually reducing supply of rough polishing slurry; and
5 wherein surface roughness after polishing is 0.5 nm or less.

1 19. The method of claim 18, wherein the polishing is performed on a double-sided
2 polishing machine to polish front and back sides of said substrate simultaneously.

1 20. Electronic devices made from bonded assemblies prepared using the method of
2 claim 18.

- 1 21. Micro-Electro-Mechanical Structures (MEMS) made from bonded assemblies
2 prepared using the method of claim 18.
- 1 22. Micro-Opto-Electro-Mechanical Structures (MOEMS) made from bonded
2 assemblies prepared using the method of claim 18.
- 1 23. A method for detection of hidden bonding flaws in multiple bonded wafers, the
2 method comprising steps of:
3 transmitting infrared radiation through a first side of a multiple bonded
4 wafer sample;
5 receiving the scattered infrared radiation exiting from a second side of said
6 sample, said second said being opposite from said first side; and
7 converting said received radiation into an electronic signal in which
8 defects appear as local maxima of said signal.